REMARKS

Claims 1-56 are pending in the application. In view of the following amendments and remarks, Applicant respectfully requests that this application be allowed and forwarded on to issuance.

The § 112 Rejections

Claims 23 and 34 stand rejected under 35 U.S.C. § 112, first paragraph, as being based on a disclosure which is not enabling. In making out this rejection, the Office states that the claim language does not have any logical meaning, because it is not clear whether the invention uses a single polygon or a plurality of polygons. The Office goes on to pose the following questions:

> How does the approximation of an object can be detected with only one polygon?;
> If it does, what happens the space between the polygons, which do not share vertices?

Claim 23 depends from claim 16. Claim 16 recites "[i]n a computer graphic processing system in which a ray is cast toward an object represented by a collection of pre-determined shapes, a method for determining which of the shapes are intersected by the ray, the method comprising [emphasis added]:

- defining a collection of ***polygons*** that approximate an object, individual polygons having a plurality of vertices;
- casting a ray toward the approximated object;
- defining a reference object relative to the collection of ***polygons*** and that contains the cast ray;
- pre-characterizing at least some vertices of at least some of the ***polygons*** to provide characteristic data that describes the vertices' positions relative to the reference object; and

- using the characteristic data to ascertain the positions of the individual ***polygons*** relative to the reference object."

Claim 23 recites "wherein none of said ***polygons*** share a ***vertex***." The Office is in an apparent quandary because the Office does not understand whether this claim refers to a single polygon or a plurality of polygons. Applicant respectfully submits that it is abundantly clear from the context of claim 23, in light of its independent claim 16, that claim 23 refers to "said polygons", where "said polygons" are, in turn, those polygons that are referenced in claim 16. Turning attention to claim 16, "said polygons" refers to the "collection of polygons." Therefore, claim 16 refers to a plurality of polygons. This fact should answer the first and second questions posed by the Office above. In addition, Applicant gave an example of subject matter that would be covered by this claim in its paper entitled "Response to Office Action Dated December 26, 2002", previously filed with the Office.

Applicant does not understand the Office's confusion or the Office's articulation of this rejection. Particularly, the Office states, in making out this rejection, that the "claim languages are not following the specification languages."

Throughout Applicant's specification, various embodiments are discussed in terms of polygons and collections of polygons. The specification states that triangles constitute an example of such polygons. As an example, consider page 10, lines 1-9 set forth below:

> As shown, a collection of shapes is first defined to approximate an object in connection with a computer graphics program. In this example, the surface of the object is approximated by a collection of shapes. Fig. 3 shows an exemplary portion of such a collection generally at 300. Any suitable shapes can be used. In the described embodiment, the shapes have

a similar geometry. ***Typically, polygons having a plurality of vertices are used.*** As will become apparent below, it is advantageous to select polygons that collectively have more faces than vertices when approximating the surface of an object. ***In the illustrated example, the polygons comprise triangles.***

Applicant simply does not understand why the Office does not understand that the claim language is indeed following the language of the specification. The specification introduces the notion of using polygons to approximate an object, and then introduces the notion that one example of such a polygon is a triangle.

Applicant respectfully submits that there is nothing non-enabling about the subject matter of these claims. Perhaps the Office is unclear about what is meant by the term "vertex"—which is a point of intersection of two lines. Examples of vertices appear in Applicant's Fig. 3 and are designated "V_{1-7}". In that example, all of the triangles share at least one vertex. It is possible, however, for a polygonal or triangle collection to approximate an object without sharing any vertices or end points. One example of such a collection was provided and discussed in the previously-filed paper mentioned above. In view of the above discussion, Applicant traverses the Office's rejection.

Claim 34 depends from claim 27. Claim 27 recites "[i]n a computer graphic processing system in which a ray is cast toward an object represented by a collection of pre-determined shapes, a method for determining which of the shapes are intersected by the ray, the method comprising [emphasis added]:

- defining a plurality of ***triangles*** that approximate an object, individual triangles having three ***vertices***;
- casting a ray toward the approximated object;
- defining at least one plane relative to the approximated object to contain the ray;

- pre-characterizing the ***vertices*** of the plurality of ***triangles*** to provide characteristic data that describes the positions of the ***vertices*** relative to said at least one plane; and
- using the characteristic data to ascertain the positions of the individual ***triangles*** relative to said at least one plane."

Claim 34 recites "wherein none of the ***triangles*** share any ***vertices***." Applicant respectfully submits, for all of the reasons set forth above with respect to claim 23, that the rejection of this claim is traversed.

The § 102 Rejections

Claims 1-22, 24-33, and 35-56 stand rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,249,287 to Yamrom.

Before discussing the substantive rejections, the following discussion of Applicant's specification and then Yamrom is provided to attempt to assist the Office in appreciating the distinctions between the two references.

Applicant's Specification

Perhaps a good starting point for appreciating the context and subject matter of Applicant's disclosure is in the "Background" section of the application. There, Applicant discusses one of the issues or problems that pertains to ray intersection techniques. Specifically, Applicant instructs that a majority of the processing that takes place in connection with ray-intersection concerns searching for an object that is intersected by a cast ray. Where particular surfaces of objects are approximated by a plurality of shapes, e.g. triangles, conventional searching takes place by determining whether or not ***each and every shape*** that constitutes the approximated surface of an object is intercepted by the cast ray. For example,

if the surface of an object is approximated by 6500 triangles, conventional searching algorithms test a first triangle to determine whether the cast ray intercepts it. If the first triangle is not intercepted by the cast ray, then the next triangle is tested and so on. Needless to say, processing each of the shapes used to approximate the surface of an object, while effective, is not the most optimal approach to the problem.

Applicant's disclosures then goes on to describe a number of embodiments that are directed to improving upon this past approach. More specifically, in accordance with various embodiments described in Applicant's specification, a collection of shapes is first defined that approximates an object. Examples of such shapes include polygons and, in some examples, triangles. The specification instructs that various topologies can be used including triangle meshes, triangle strips, and triangle fans. In accordance with the described embodiments, a ray is cast toward the approximated object. A reference object which, in the illustrated example comprises a plane, is defined to contain the ray. For an example of a collection of shapes, a ray, and a plane that contains the ray, the reader is referred to Figs. 3 and 8.

With the plane and ray having been defined, aspects of the individual shapes are pre-characterized to provide characteristic data. In the illustrated example, pre-characterization takes place by testing each of the vertices of the polygons that make up the approximated object to ascertain their position relative to the reference object. With all of the vertices having been pre-characterized, the characteristic data is used to ascertain the position of the shapes relative to the reference object. This defines a sub-set of shapes that might be intersected by the

ray. For an example of shapes that might be intersected by the ray, the reader is referred to Fig. 9.

The sub-set of shapes is then evaluated to ascertain which of the shapes is intersected by the ray. For an example of a shape that is intersected by the ray, the reader is referred to Fig. 10.

The specification further instructs that the inventive methods and apparatus greatly facilitate computer graphics processing by reducing processing complexities associated with ray-intersection. Advancements are achieved by reducing the number of shapes in a collection that must be evaluated for ray intersection. The various embodiments achieve their processing advances by recognizing that aspects of the shapes can be pre-processed prior to subjecting them to intersection processing. By pre-characterizing the vertices of the polygons, certain polygons are ruled out before they are processed by an intersection algorithm.

The above discussion should provide an adequate context from which to appreciate the distinctions between the claimed subject matter and Yamrom.

The Yamrom Reference

Yamrom is not concerned with nor does it pertain to the problem or solution that Applicant's disclosure respectively addresses and presents—that of reducing processing complexities associated with ray-intersection by ruling out certain shapes that represent an object before the shapes are processed by an intersection algorithm. Understanding that Yamrom is not concerned with the same problem that Applicant's disclosure addresses facilitates an appreciation that Yamrom's

methods and systems are decidedly different from Applicant's claimed subject matter.

Yamrom is directed to a method for ***modeling an object*** with a polygonal mesh. In accordance with Yamrom's method, a closed-surface polygonal mesh is obtained and positioned relative to the object that is to be modeled. A ray is then projected through a point-of-interest on the closed-surface polygonal mesh and an intersection point between the ray and a surface of the object is determined. The location of the point-of-interest is adjusted in response to the location of the intersection point, and this is performed for a number of points in the closed-surface polygonal mesh in order to approximate the object.

Exploring this notion is a bit more detail, Yamrom instructs, in column 2 starting at line 31, that its methodology fits a reduced mesh to the surface of an object to approximate the object. If the object is a complex model, the reduced mesh has fewer polygons (e.g. triangles) than the complex model but still accurately represents the surface to be modeled and maintains a predetermined degree of smoothness. Yamrom's approach uses a reduced mesh made up of a closed mesh with a relatively small number of polygons that is placed inside or outside of an unprocessed complex model containing many thousands of polygons. Points of the reduced mesh are then projected to a projected position to approximate the surface of the complex model. The resulting projection of the reduced mesh has fewer polygons than the complex model, is closed, and approximates the surface of the original, complex model. Yamrom instructs that any holes or irregularities in the original, complex model are sealed and smoothed by the process of projecting the closed, reduced mesh.

For an example of Yamrom's approach, reference is made to Figs. 3, 4 and 5. Fig. 3, as noted by the Office, is a flowchart of a general method of modeling a closed surface. At step 10, a reduced mesh having a predetermined number of polygons is positioned relative to the object to be represented by the reduced mesh. The reduced mesh may be positioned inside or outside the object. At step 12, a ray is projected through a point of the mesh (for example, a vertex of a polygon). Fig. 4 illustrates the process of projecting a ray through a point of the reduced mesh. A ray 34 is generated from a start point 30 through point-of-interest 32, which may correspond to a vertex of a polygon 35 in the reduced mesh. The reduced mesh is a closed surface. The intersection of the ray 34 and the surface 36 of the object defines an intersection point 38. Fig. 5 shows a similar projection in which the object is placed inside the reduced mesh. Due to holes in the object, the ray 34 may not intersect the surface 36. At step 14, it is determined whether ray 34 intersects surface 36. If so, flow proceeds to step 16 where the location of the intersection point 38 is used to determine a projected position of the reduced mesh point 32. In some instances, the projected position of point 32 will be the intersection point 38. The projected position can also be distanced from the surface 36 of the object and still provide a good approximation of the object. If at step 14, it is determined that the ray 34 does not intersect surface 36, then flow proceeds to step 18 where the projected position is determined based on a reference distance. Both steps 16 and 18 proceed to step 20 where the process ends if all points are processed. If not, step 22 locates the next point for processing.

Claims 1-15

Claim 1 recites a method for determining which shapes are intersected by a ray in a computer graphic processing system in which a ray is cast toward an object represented by a collection of pre-determined shapes each characterized by characteristic data. The method recites:

- defining a reference object relative to the represented object;
- determining the positions of the shapes relative to the reference object using the characteristic data; and
- determining, on the basis of the positions of the shapes relative to the reference object, those shapes that have ***no chance of intersecting the ray,*** and those remaining shapes that ***may intersect the ray***.

In making out the rejection of this claim, the Office argues that its subject matter is anticipated by Yamrom. In making out the rejection, the Office makes a number of interpretations with respect to Applicant's claim terminology and Yamrom's disclosure. Applicant has tried to follow the Office's interpretation of Yamrom and its application to the claimed subject matter, but cannot follow the logic that the Office uses. To the extent that Applicant understands the Office's interpretation of Yamrom, Applicant disagrees with the Office's interpretation and application of this reference.

Applicant has studied Yamrom in detail and submits that claim 1 recites subject matter that is neither anticipated by nor rendered obvious in view of Yamrom. For example, this claim recites an act of "determining, on the basis of the positions of the shapes (i.e. the previously-recited collection of predetermined shapes which the Office equates to Yamrom's polygon mesh) relative to the reference object, those shapes that have ***no chance of intersecting the ray,*** and

those remaining shapes that ***may intersect the ray***." (emphasis added). The Office appears to equate this subject matter to Yamrom's methodology as described in Fig. 3's steps 14-20. Yamrom's methodology does not determine shapes that have no chance of intersecting the ray and remaining shapes that *may* intersect the ray. Rather, Yamrom determines whether its ray intersects an object's surface 36 (Fig. 4). If it does, then a point on its reduced mesh is adjusted in response to the intersection point. If the ray does not intersect the object's surface 36, then the point on the reduced mesh is adjusted a reference distance. Yamrom's method then moves on to other points on other shapes of the reduced mesh and presumably other rays that are cast through points of interest relative to the reduced mesh.

Nowhere does Yamrom, in casting its ray through a point of interest 32 on a polygon 35 of the reduced mesh to intersect a surface of a complex object, ascertain any shapes that "have no chance of intersecting the ray, and those remaining shapes that *may* intersect the ray." Rather, the analysis that Yamrom performs responsive to its cast ray is that which is concerned ***only*** with the point of intersection 38, if one exists. There is no analysis or concern for shapes that have no chance of intersecting the ray, and those remaining shapes that *may* intersect the ray.

The reason for this is easy to understand when one considers the different contexts as between Applicant's claimed subject matter and Yamrom's subject matter. These different contexts drive very different methodologies, as noted above.

In view of the above discussion, Yamrom neither anticipates nor renders obvious the subject matter of claim 1. Accordingly, for at least this reason, claim 1 is allowable.

Claims 2-15 depend from claim 1 and are allowable as depending from an allowable base claim. These claims are also allowable for their own recited features which, in combination with those recited in claim 1, are neither disclosed nor suggested in the references of record, either singly or in combination with one another.

Claims 16-23

Claim 16 recites a method for determining which of a collection of pre-determined shapes are intersected by a ray cast toward an object that is represented by the shapes. The method recites:

- defining a collection of polygons that approximate an object, individual polygons having a plurality of vertices;
- casting a ray toward the approximated object;
- defining a reference object relative to the collection of polygons and that ***contains the cast ray***;
- pre-characterizing at least some vertices of at least some of the polygons to provide characteristic data that describes the vertices' positions relative to the reference object; and
- using the characteristic data to ascertain the positions of the individual polygons relative to the reference object.

In making out the rejection of this claim, the Office characterizes Yamrom in much the same way as it did in making out the rejection of claim 1. Applicant disagrees with the Office's interpretation and application of Yamrom. Applicant has studied Yamrom and can find no disclosure of a step that defines a reference

object relative to the collection of polygons and that ***contains the cast ray***, as that term is used in Applicant's claim and specification. Rather, there appears to be no object whatsoever in Yamrom that "contains" the cast ray. Although the ray passes through various objects such as the reduced mesh 35 and the complex object surface 36, there is no "reference object" that "contains the cast ray". The reason for this is understandable as one appreciates the contextual differences between Yamrom and the subject matter of this claim as pointed out above. As Yamrom neither discloses nor suggests the subject matter recited in the second act of "defining" above, it is virtually impossible for Yamrom to disclose or suggest the recited acts that follow and rely upon this act. Accordingly, this claim is allowable as it is neither anticipated by nor rendered obvious in view of Yamrom.

Claims 17-23 depend from claim 16 and are allowable as depending from an allowable base claim. These claims are also allowable for their own recited features which, in combination with those recited in claim 16, are neither disclosed nor suggested by the references of record, either singly or in combination with one another.

Claims 24-26

Claim 24 recites in a computer graphic processing system in which a ray is cast toward an object represented by a collection of pre-determined shapes, a method for determining which of the shapes are intersected by the ray, the method comprising:

- defining a collection of polygons that approximate an object, individual polygons having a plurality of vertices;
- casting a ray toward the approximated object;

- ***defining a reference object relative to the collection of polygons and that contains the cast ray***;
- pre-characterizing at least some vertices of at least some of the polygons to provide characteristic data that describes the vertices' positions relative to the reference object; and
- using the characteristic data to ascertain the positions of the individual polygons relative to the reference object, wherein said using of the characteristic data comprises determining whether an individual polygon is in a sub-set of polygons that might be intersected by the ray.

In making out the rejection of this claim, the Office uses and characterizes Yamrom in much the same way as it did above. Applicant has studied Yamrom in detail and can find no disclosure or suggestion that Yamrom defines a reference object relative to the collection of polygons and that ***contains the cast ray***. As noted, the conspicuous absence of this subject matter from Yamrom is understandably explained due to the contextual differences between Yamrom and the subject matter recited in this claim. As Yamrom neither discloses nor suggests the subject matter recited in this claim element it is virtually impossible for Yamrom to disclose or suggest the recited acts that follow and rely upon this act. Accordingly, this claim is allowable as it is neither anticipated by nor rendered obvious in view of Yamrom.

Claim 25 recites in a computer graphic processing system in which a ray is cast toward an object represented by a collection of pre-determined shapes, a method for determining which of the shapes are intersected by the ray, the method comprising:

- defining a collection of polygons that approximate an object, individual polygons having a plurality of vertices;
- casting a ray toward the approximated object;

- ***defining a reference object relative to the collection of polygons and that contains the cast ray;***
- pre-characterizing at least some vertices of at least some of the polygons to provide characteristic data that describes the vertices' positions relative to the reference object; and
- using the characteristic data to ascertain the positions of the individual polygons relative to the reference object, wherein said using of the characteristic data comprises determining whether an individual polygon is in a sub-set of polygons at least some of which straddle the reference object.

In making out the rejection of this claim, the Office uses and characterizes Yamrom in much the same way as it did above. Applicant has studied Yamrom in detail and can find no disclosure or suggestion that Yamrom defines a reference object relative to the collection of polygons and that ***contains the cast ray***. As noted, the conspicuous absence of this subject matter from Yamrom is understandably explained due to the contextual differences between Yamrom and the subject matter recited in this claim. As Yamrom neither discloses nor suggests the subject matter recited in this claim element it is virtually impossible for Yamrom to disclose or suggest the recited acts that follow and rely upon this act. Accordingly, this claim is allowable as it is neither anticipated by nor rendered obvious in view of Yamrom.

Claim 26 recites in a computer graphic processing system in which a ray is cast toward an object represented by a collection of pre-determined shapes, a method for determining which of the shapes are intersected by the ray, the method comprising:

- defining a collection of polygons that approximate an object, individual polygons having a plurality of vertices;
- casting a ray toward the approximated object;

- ***defining a reference object relative to the collection of polygons and that contains the cast ray;***
- pre-characterizing at least some vertices of at least some of the polygons to provide characteristic data that describes the vertices' positions relative to the reference object;
- using the characteristic data to ascertain the positions of the individual polygons relative to the reference object, wherein said using of the characteristic data comprises determining whether an individual polygon is in a sub-set of polygons at least some of which straddle the reference object; and
- evaluating the sub-set of polygons to determine which polygons are intersected by the ray.

In making out the rejection of this claim, the Office uses and characterizes Yamrom in much the same way as it did above. Applicant has studied Yamrom in detail and can find no disclosure or suggestion that Yamrom defines a reference object relative to the collection of polygons and that ***contains the cast ray***. As noted, the conspicuous absence of this subject matter from Yamrom is understandably explained due to the contextual differences between Yamrom and the subject matter recited in this claim. As Yamrom neither discloses nor suggests the subject matter recited in this claim element it is virtually impossible for Yamrom to disclose or suggest the recited acts that follow and rely upon this act. Accordingly, this claim is allowable as it is neither anticipated by nor rendered obvious in view of Yamrom.

Claim 27 recites in a computer graphic processing system in which a ray is cast toward an object represented by a collection of pre-determined shapes, a method for determining which of the shapes are intersected by the ray, the method comprising:

- defining a plurality of triangles that approximate an object, individual triangles having three vertices;
- casting a ray toward the approximated object;
- ***defining at least one plane relative to the approximated object to contain the ray;***
- pre-characterizing the vertices of the plurality of triangles to provide characteristic data that describes the positions of the vertices relative to said at least one plane; and
- using the characteristic data to ascertain the positions of the individual triangles relative to said at least one plane.

In making out the rejection of this claim, the Office uses and characterizes Yamrom in much the same way as it did above. Applicant has studied Yamrom in detail and can find no disclosure or suggestion that Yamrom defines at least one plane relative to the approximated to contain the ray. As noted, the conspicuous absence of this subject matter from Yamrom is understandably explained due to the contextual differences between Yamrom and the subject matter recited in this claim. As Yamrom neither discloses nor suggests the subject matter recited in this claim element it is virtually impossible for Yamrom to disclose or suggest the recited acts that follow and rely upon this act. Accordingly, this claim is allowable as it is neither anticipated by nor rendered obvious in view of Yamrom.

Claims 28-30 and 34-36 depend from claim 27 and are allowable as depending from an allowable base claim. These claims are also allowable for their own recited features which, in combination with those recited in claim 27, are neither disclosed nor suggested by the references of record, either singly or in combination with one another.

Claim 31 recites in a computer graphic processing system in which a ray is cast toward an object represented by a collection of pre-determined shapes, a

method for determining which of the shapes are intersected by the ray, the method comprising:

- defining a plurality of triangles that approximate an object, individual triangles having three vertices;
- casting a ray toward the approximated object;
- ***defining at least one plane relative to the approximated object to contain the ray;***
- pre-characterizing the vertices of the plurality of triangles to provide characteristic data that describes the positions of the vertices relative to said at least one plane; and
- using the characteristic data to ascertain the positions of the individual triangles relative to said at least one plane, wherein said using of the characteristic data comprises determining whether a particular individual triangle has a chance of being intersected by the ray.

In making out the rejection of this claim, the Office uses and characterizes Yamrom in much the same way as it did above. Applicant has studied Yamrom in detail and can find no disclosure or suggestion that Yamrom defines at least one plane relative to the approximated to contain the ray. As noted, the conspicuous absence of this subject matter from Yamrom is understandably explained due to the contextual differences between Yamrom and the subject matter recited in this claim. As Yamrom neither discloses nor suggests the subject matter recited in this claim element it is virtually impossible for Yamrom to disclose or suggest the recited acts that follow and rely upon this act. Accordingly, this claim is allowable as it is neither anticipated by nor rendered obvious in view of Yamrom.

Claim 32 recites in a computer graphic processing system in which a ray is cast toward an object represented by a collection of pre-determined shapes, a

method for determining which of the shapes are intersected by the ray, the method comprising:

- defining a plurality of triangles that approximate an object, individual triangles having three vertices;
- casting a ray toward the approximated object;
- ***defining at least one plane relative to the approximated object to contain the ray;***
- pre-characterizing the vertices of the plurality of triangles to provide characteristic data that describes the positions of the vertices relative to said at least one plane; and
- using the characteristic data to ascertain the positions of the individual triangles relative to said at least one plane, wherein said using of the characteristic data comprises determining whether a particular individual triangle straddles said at least one plane.

In making out the rejection of this claim, the Office uses and characterizes Yamrom in much the same way as it did above. Applicant has studied Yamrom in detail and can find no disclosure or suggestion that Yamrom defines at least one plane relative to the approximated to contain the ray. As noted, the conspicuous absence of this subject matter from Yamrom is understandably explained due to the contextual differences between Yamrom and the subject matter recited in this claim. As Yamrom neither discloses nor suggests the subject matter recited in this claim element it is virtually impossible for Yamrom to disclose or suggest the recited acts that follow and rely upon this act. Accordingly, this claim is allowable as it is neither anticipated by nor rendered obvious in view of Yamrom.

Claim 33 recites in a computer graphic processing system in which a ray is cast toward an object represented by a collection of pre-determined shapes, a method for determining which of the shapes are intersected by the ray, the method comprising:

- defining a plurality of triangles that approximate an object, individual triangles having three vertices;
- casting a ray toward the approximated object;
- ***defining at least one plane relative to the approximated object to contain the ray;***
- pre-characterizing the vertices of the plurality of triangles to provide characteristic data that describes the positions of the vertices relative to said at least one plane;
- using the characteristic data to ascertain the positions of the individual triangles relative to said at least one plane, wherein said using of the characteristic data comprises defining a sub-set of triangles at least some of which straddle the plane; and
- evaluating the sub-set of triangles to ascertain which triangles are intersected by the ray.

In making out the rejection of this claim, the Office uses and characterizes Yamrom in much the same way as it did above. Applicant has studied Yamrom in detail and can find no disclosure or suggestion that Yamrom defines at least one plane relative to the approximated to contain the ray. As noted, the conspicuous absence of this subject matter from Yamrom is understandably explained due to the contextual differences between Yamrom and the subject matter recited in this claim. As Yamrom neither discloses nor suggests the subject matter recited in this claim element it is virtually impossible for Yamrom to disclose or suggest the recited acts that follow and rely upon this act. Accordingly, this claim is allowable as it is neither anticipated by nor rendered obvious in view of Yamrom.

Claims 37-42

Claim 37 recites a method for determining which of a number of polygons that represent an object are intersected by a ray that is cast at the object. The method recites:

- defining a sub-set of polygons from a collection of polygons that approximate an object by determining which polygons have vertices that satisfy a predefined relationship relative to a reference object; and
- evaluating the sub-set of polygons to ascertain which of the polygons is intersected by a cast ray.

In making out the rejection of this claim, the Office cites to Yamrom's abstract section and to Figs. 3-5 and makes arguments similar to those made above. In fact, the Office appears to use some of the same claim terminology that appears in other claims and not in this claim, in making out the rejection of this claim. Because the Office does not specifically apply Yamrom to the specific claim elements in this claim, Applicant is a bit unclear of the Office's official position with respect to this reference and how it purportedly anticipates this claim's subject matter. Nonetheless, Applicant has studied Yamrom and can find no disclosure or suggestion of this claim's subject matter. Specifically, this claim recites "***defining a sub-set*** of polygons from a collection of polygons that approximate an object ***by determining which polygons have vertices that satisfy a predefined relationship relative to a reference object.***" Yamrom does not appear to disclose any such method in which a sub-set of polygons is defined by determining which polygons from a collection of polygons have vertices that satisfy a predefined relationship relative to a reference object. As Yamrom neither

discloses nor suggests any such subject matter, it is virtually impossible for Yamrom to disclose or suggest the subject matter of the second-recited claim element which relies on the first-recited claim element. Accordingly, this claim is allowable.

Claims 38-39 and 41-42 depend from claim 37 and are allowable as depending from an allowable base claim. These claims are also allowable for their own recited features which, in combination with those recited in claim 37, are neither disclosed nor suggested by the references of record, either singly or in combination with one another.

Claim 40 recites in a computer graphic processing system in which a ray is cast toward an object represented by a collection of pre-determined polygons, a method for determining which of the polygons are intersected by the ray, the method comprising:

- defining a sub-set of polygons from a collection of polygons that approximate an object by determining which polygons have vertices that satisfy a predefined relationship relative to a reference object, wherein the reference object comprises a plane; and
- evaluating the sub-set of polygons to ascertain which of the polygons is intersected by a cast ray,
- wherein said determining comprises determining which polygons straddle the plane.

In making out the rejection of this claim, the Office cites to Yamrom's abstract section and to Figs. 3-5 and makes arguments similar to those made above. In fact, the Office appears to use some of the same claim terminology that appears in other claims and not in this claim, in making out the rejection of this claim. Because the Office does not specifically apply Yamrom to the specific

claim elements in this claim, Applicant is a bit unclear of the Office's official position with respect to this reference and how it purportedly anticipates this claim's subject matter. Nonetheless, Applicant has studied Yamrom and can find no disclosure or suggestion of this claim's subject matter. Specifically, this claim recites "***defining a sub-set*** of polygons from a collection of polygons that approximate an object ***by determining which polygons have vertices that satisfy a predefined relationship relative to a reference object***." Yamrom does not appear to disclose any such method in which a sub-set of polygons is defined by determining which polygons from a collection of polygons have vertices that satisfy a predefined relationship relative to a reference object. As Yamrom neither discloses nor suggests any such subject matter, it is virtually impossible for Yamrom to disclose or suggest the subject matter of the second-recited claim element which relies on the first-recited claim element. Accordingly, this claim is allowable.

Claims 43-47

Claim 43 recites a computer graphic processing system comprising a programmable computer programmed with computer-readable instructions which, when executed by the programmable computer, implement the following method:

- defining a plurality of polygons that approximate an object, individual polygons having a plurality of vertices;
- casting a ray toward the approximated object;
- ***defining at least one plane relative to the approximated object to contain the ray;***
- pre-characterizing the vertices of the plurality of polygons to provide characteristic data that describes the positions of the vertices relative to said at least one plane;

- using the characteristic data to ascertain the positions of the individual polygons relative to said at least one plane;
- determining which of the individual polygons might be intersected by the ray, based upon their ascertained positions, to provide a sub-set of polygons; and
- evaluating the sub-set of polygons to ascertain which of the polygons are intersected by the ray.

In making out the rejection of this claim, the Office uses and characterizes Yamrom in much the same way as it did above. Applicant has studied Yamrom in detail and can find no disclosure or suggestion that Yamrom defines at least one plane relative to the approximated to contain the ray. As noted, the conspicuous absence of this subject matter from Yamrom is understandably explained due to the contextual differences between Yamrom and the subject matter recited in this claim. As Yamrom neither discloses nor suggests the subject matter recited in this claim element it is virtually impossible for Yamrom to disclose or suggest the recited acts that follow and rely upon this act. Accordingly, this claim is allowable as it is neither anticipated by nor rendered obvious in view of Yamrom.

Claims 44-47 depend from claim 43 and are allowable as depending from an allowable base claim. These claims are also allowable for their own recited features which, in combination with those recited in claim 43, are neither disclosed nor suggested by the references of record, either singly or in combination with one another.

Claim 48 recites one or more computer-readable media having computer-readable instructions thereon which, when executed by a computer graphic processing system, implement the following method:

- defining a plurality of triangles that approximate an object, individual triangles having three vertices;
- casting a ray toward the approximated object;
- ***defining at least one plane relative to the approximated object to contain the ray;***
- pre-characterizing the vertices of the plurality of triangles to provide characteristic data that describes the positions of the vertices relative to said at least one plane;
- using the characteristic data to ascertain the positions of the individual triangles relative to said at least one plane;
- determining which of the individual triangles might be intersected by the ray, based upon their ascertained positions, to provide a sub-set of triangles; and
- evaluating the sub-set of triangles to ascertain which of the triangles are intersected by the ray.

In making out the rejection of this claim, the Office uses and characterizes Yamrom in much the same way as it did above. Applicant has studied Yamrom in detail and can find no disclosure or suggestion that Yamrom defines at least one plane relative to the approximated to contain the ray. As noted, the conspicuous absence of this subject matter from Yamrom is understandably explained due to the contextual differences between Yamrom and the subject matter recited in this claim. As Yamrom neither discloses nor suggests the subject matter recited in this claim element it is virtually impossible for Yamrom to disclose or suggest the recited acts that follow and rely upon this act. Accordingly, this claim is allowable as it is neither anticipated by nor rendered obvious in view of Yamrom.

Claim 49 depends from claim 48 and is allowable as depending from an allowable base claim. This claim is also allowable for its own recited features which, in combination with those recited in claim 48, are neither disclosed nor suggested by the references of record, either singly or in combination with one another.

Claims 50-56

Claim 50 recites a computer graphic processing system comprising:

- a processor;
- memory; and
- software code stored in the memory that causes the processor to implement a ray-intersection algorithm which:
  - casts a ray at a collection of shapes that approximate an object;
  - ***defines a reference object that contains the ray***;
  - pre-characterizes aspects of individual ones of the shapes of the collection to provide characteristic data; and
  - uses the characteristic data to ascertain the position of the shapes of the collection of shapes relative to the reference object.

In making out the rejection of this claim, the Office uses and characterizes Yamrom in much the same way as it did above. Applicant has studied Yamrom in detail and can find no disclosure or suggestion that Yamrom defines a reference object that contains the recited ray. As noted, the conspicuous absence of this subject matter from Yamrom is understandably explained due to the contextual differences between Yamrom and the subject matter recited in this claim. As Yamrom neither discloses nor suggests the subject matter recited in this claim element it is virtually impossible for Yamrom to disclose or suggest the recited acts that follow and rely upon this act. Accordingly, this claim is allowable as it is neither anticipated by nor rendered obvious in view of Yamrom.

Claims 51-56 depend from claim 50 and are allowable as depending from an allowable base claim. These claims are also allowable for their own recited features which, in combination with those recited in claim 50, are neither disclosed

nor suggested by the references of record, either singly or in combination with one another.

Conclusion

Applicant submits that all of the claims are in condition for allowance and respectfully requests that the Office pass the application along to issuance. If the Office's next anticipated action is to be anything other than issuance of a Notice of Allowability, Applicant respectfully requests a telephone call for the purpose of scheduling an interview.

Respectfully Submitted,

Dated: 4/23/04

By: _____

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